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Witness Statement

Written Testimony on Ocean Exploration

Delivered to the Resources Subcommittee on Fisheries Conservation, Wildlife and Oceans and the Science Subcommittees on Research and Environment, Technology and Standards

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Thank you, Chairmen Gilchrest, Ehlers, and Smith, for this opportunity to speak to you about a topic that I care about most passionately, Ocean Exploration.

Since time is limited, I will cut right to the important issues regarding ocean exploration: Why, What, Where, When, Who, How, and How Much.

Why does the US need a program in ocean exploration? It is very simple. The ocean is essential to life on Earth. The ocean is Earth's largest living space and contains most of its biomass. Eighty percent of all known phyla are found only in the ocean, and most photosynthesis occurs there. The ocean moderates our climate to keep Earth habitable, and it processes our wastes. The ocean provides an inexpensive source of protein to feed the global population. Yet 95% of the ocean is unknown and unexplored. How could that have happened? During the great era of exploration from the 15th through the 18th centuries, the target was unknown lands: the New World, the Dark Continent, Terra Incognita. Many of the explorers of that era were indeed superb mariners - Columbus, Magellan, Drake, Cook – but the ocean itself was not the target of their journeys. It was merely a barrier that needed to be crossed in order to claim new lands and discover new riches. The technology did not even exist at that time to explore the ocean itself. By the time we developed the platforms and instruments that could explore the ocean and its depths, exploration had gone out of favor as most of the land surface had already been catalogued, and the vast resources of the oceans were unappreciated. To be sure, much has been learned about the oceans through research programs supported by Federal agencies, primarily NSF, the Navy, and NOAA. But research is distinct from exploration. Exploration leads to questions. Research finds answers. Every day Congress and other legislative bodies are asked to make policy decisions concerning the oceans, based on the best scientific answers to those posed questions. But what if we don't know enough to ask the right questions? For example, some are now proposing direct sequestration of carbon dioxide in the ocean, below 3 km depth, as a way to circumvent the atmospheric release that leads to global warming. But how can we assess the

biological impact of ocean sequestration when we don't know all of the creatures that live in those regions, much less the role they play in the overall health of the ocean ecosystem? As another example, my institution's ocean observatories documented a 25% drop in ocean productivity in Monterey Bay in the decade of the 1990's caused by a 1 degree Fahrenheit rise in ocean surface temperature. This extreme effect was not predicted by the sophisticated computer models because we have not explored the ocean sufficiently in the time domain to ask the right questions of the models. In order to know the right questions to even ask, the U.S. needs a program in ocean exploration.

What is Ocean Exploration? Ocean exploration is the systematic observation of all facets of the ocean (biological, physical, chemical, geological, archeological, etc.) in all three dimensions of space and the fourth dimension of time. Ocean exploration leaves a legacy of carefully documented information for posterity, to address questions we do not know enough to even pose at the time that the data are collected. Ocean exploration pushes the envelope for technology as we attempt to gain access to Earth's most challenging environments. Ocean exploration leads to great, but largely unpredictable, rewards: cures for diseases from novel biological compounds, untapped mineral, energy, and biological resources, insight as to how the ocean system functions, geological and biological vistas of unsurpassed beauty, appreciation for mankind's maritime past. Ocean exploration captures the attention of the public and provides engaging content for improving math and science literacy.

Where should we explore? The highest priority for U.S. ocean exploration should be the underwater territories under our jurisdiction. As stewards of these areas, we have a moral obligation to concentrate our efforts there. It is also in these areas that we are most likely to protect and profit from new discovers. The second priority is the Arctic Ocean, largely unexplored and yet the sentinel for global climate change. Other priorities are the vast Southern Ocean and inland seas, where a significant portion of our cultural heritage awaits discovery.

When should exploration begin? Probably twenty years ago. But better late than never. A number of other nations have already begun programs to explore their territorial waters. Even Ireland has an ambitious program to map its entire (and large) Exclusive Economic Zone, and is already reaping rewards in terms of new discoveries from its efforts. A number of other nations (Japan, France, Russia) have invested in technology for ocean exploration that is decades newer than what is currently available to the U.S. research community. I don't understand that why a country that has won world wars, walked on the Moon, and increased the standard of living of its citizens through superior technology could allow itself to sink to second tier status when it comes to something as important as the oceans. To own the technology is to own the oceans.

Who should be involved? Expeditions should be led by explorers, with broad interdisciplinary backgrounds, who understand the importance of observing everything, regardless of whether it relates to a specific area of their own interest. Ocean exploration should involve all stakeholders: public, private and non-profit. Business interests, universities, federal laboratories, educators, conservationists, students. NOAA, NSF, Navy, NASA, USGS, MMS, EPA, DOE. Each brings an important element to the table. The efforts of all of these groups will need to be well coordinated through some effective management structure, that includes the coordination of Federal funding. The fruits of exploration should be equally available to all stakeholders so that policy decisions can be well informed from all viewpoints. International collaborations will be essential in territorial waters of other nations and desirable in international waters as well.

How should we explore the oceans? The program will be most effective if it is systematic, with built-in programs for educational outreach and information dissemination. A plan that appealed greatly to the Ocean

Exploration Panel was to center the program around a signature mission: a poleward circumnavigation of the globe. The mission would begin in Maine, continue down the U.S. eastern seaboard, into the Gulf of Mexico, to the Equatorial and South Atlantic, around Antarctica, back up through the Indian Ocean to the western Pacific, across to Hawaii and California, northward along the Pacific Coast to Alaska, and culminating with a mission under the Arctic ice cap. In each region, the exploration would begin with reconnaissance mapping of the seafloor and water column. The next phase would involve detailed exploration by a state-of-the-art flagship equipped with new-generation submersible technology and high-bandwidth, satellite communication to bring the real-time discoveries to aquaria, schools, homes, and offices. The flagship would also be set up to archive samples and distribute validated data to data repositories and from there, over the internet. In the wake of the flagship's detailed observations, ocean observatories would be installed in key locations to continue the exploration into the time domain.

How much should the U.S. invest in ocean exploration? The Ocean Exploration Panel recommended $75M/per year for an initial period of ten years, exclusive of capital costs. This is clearly a small investment compared with the value of the ocean to the U.S. economy. We decided on this number based on several arguments. Given that the discoveries from ocean exploration will lead to questions and specific hypotheses that will need to be followed up by research programs, an Ocean Exploration Program that is approximately 10% of the size of the total federal ocean research portfolio is reasonable. Alternatively, a bottom-up calculation for the necessary components of the program: (signature mission, auxiliary explorations, technology development, the education and public outreach, the technology transfer) leads to a similar dollar estimate. Our assumption was that contributions towards ocean exploration from state and private sources and in-kind support from existing government-funded efforts would make the total investment in ocean exploration several times the nominal $75M recommended.

Summary. I hope that Congress will support ocean exploration because the ocean is a mysterious living universe critically important to the functioning of the planet. But even if you support ocean exploration only because of its potential to increase national wealth, encourage ocean conservation, improve public health, regain U.S. technological superiority, and promote science literacy for the public, aren't these reasons good enough?

The full text of the panel report is available at:
http://oceanpanel.nos.noaa.gov/

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